RANCH DAY

November 30, 1945

New Mexico Experiment Station, New Mexico Extension Service

Southwestern Forest and Range Experiment Station

Good range produces good livestock and profit for the rancher

Experimental Ranch

New Mexico College of A. and M. A.

Jornada Experimental Range

Southwestern Forest and Range Experiment Station

P R O G R A M

Ivan Watson, Extension Animal Husbandman, New Mexico
Extension Service, Presiding

LEAVE LAS CRUCES 8:00 A.M. LEAVE RADIUM SPRINGS 8:30 A.M.

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8:50 MAYFIELD WELL Effect of Rainfall on the Production of Range Cattle - P. E. Neale.

9:30 PASTURE 15 SAMPLE PLOTS Vitamin A Factor of Range Forage - W. E. Watkins.

10:15 RODENT PLOT Effect of Rodents and Rabbits on Good and Poor Range - K. A. Valentine.

HEADQUARTERS Exhibit on Display - Dr. J. L. Gardner, Soil Conservation Service, in charge.

11:10 Picking the Better Producers in the Cow Herd - Marvin Koger.

11:40 Lunch.

12:20 Welcome from J. W. Branson, Dean of the College, and Raymond Price, Director, Southwestern Forest and Range Experiment Station.

12:35 The Long-Range Outlook for the New Mexico Range Cattle Industry - E. G. Hayward, President, New Mexico Cattle Growers' Association.

1:15 RESEEDING AREA Summary of Results of Reseeding Trials - K. A. Valentine.
Range Reseeding Research in New Mexico - J. O. Bridges.

2:10 CAMP How I Select My Replacement Heifers - George A. Godfrey, Animas, N.M.
Seasonal Use of Mineral Supplements - J. H. Knox.

3:05 ENTER JORNADA - CO-OP WELL Current Conditions on the Jornada - Fred N. Ares.
My Purebred Herd - B. A. Christmas.

3:45 BRUSH CLEARED AREA Shrub Control as a Range-Improvement Practice - Kenneth W. Parker.

EFFECT OF RAINFALL ON PRODUCTION OF RANGE CATTLE

P. E. Neale

Since the range livestock man ends his production for the year about November 1 when he ships, it appears logical that in studying the effect of rainfall on production, this same date, November 1, should be the beginning of a new year. In this discussion, therefore, a "year" is considered as entending from November 1 of one year to November 1 of the next.

The livestock data are the average yearly gain of yearling steers, of calf weights, and percent of calf crop for 10 years. The yearling steer gain and calf weights were compared with the rainfall for the year in which they were on the range. The percent of calf crop born is compared with the rainfall of the previous year, since that was the year when the cows were bred.

Each year we sell the top-weight steer calves and hold back the average and lightweight steer calves for grazing until the next fall. Those are the yearlings that produce the yearling steer gains shown in the table.

The percentage of calf crop and weight of calf data will be better understood if the reader keeps in mind that seasonal breeding is practiced on this ranch, the bulls being with the cows only through June, July, and August. Since the average birth date of calves is about April 1 and the weaning date about October 15, they are approximately 6 1/2 months old when the final weights are taken.

The average rainfall for 10 years--1936 to 1945 inclusive, is 9.84 inches. The months of February, March, April, and May are the lowest with an average monthly rainfall of .315 inch or a little less than 1/3 inch per month. July, August, and September are the highest-rainfall months with an average of 1.693 inches or about 1 3/4 inches per month. June, October, November, December, and January are the intermediate months with an average of .61 inch or a little over 1/2 inch per month. With frost dates of October 17 and April 17 and the low rainfall in May and June, the year's feed crop must be produced in July, August, and September and half of October.

The 10 years' average rainfall is of little use in predicting production for any one year. This is because the total rainfall fluctuates from year to year; for instance, 1941 had a high of 18.8 inches and 1943 a low of 6.8 inches. The extreme high of 18.8 inches raised the 10-year average so much that 7 years out of the 10 were below average. Possibly more than 10 years are needed to find an accurate average. Even the total amount of rainfall in any one year, except in extremely low years such as 1943, is not reliable as an index for amount of production. The table shows that yearly steer gains were affected by annual rainfall only about half the time, calf weights about one-third the time, and percent of calves about one-third of the time.

In an effort to explain these differences in production which are apparently not affected greatly by total amount of rainfall (unless there be extreme variations), a chart was set up using rainfall for single months and series of months. The year's gain was then set up beside each of these series for each of the 10 years. This showed that the rainfall of the 4 late winter and early spring months of January, February, March, and April were good for estimating yearling steer

YEARLY RAINFALL, NOVEMBER 1 TO NOVEMBER 1, YEARLING STEER GAINS, CALF WEIGHTS, AND PERCENT OF CALF CROP FOR 10 YEARS

10 years successive rainfall with livestock production each year				Same 10 years of rainfall arranged in order of amount of rainfall				
Year	Average rainfall	Yearling steer gain	Calf weight	Percent calf crop of next year	Year	Average rainfall	Yearling steer gain	Calf weight	Percent calf crop of next year
	Inches	Lbs.	Lbs.	Percent		Inches	Lbs.	Lbs.	Percent
1936	9.275	356	445	90.1	1941	18.799	355	429*	96.1
1937	8.553	353	448	92.0	1944	10.495	363	406*	92.7*
1938	9.279	313	437	95.1	1940	10.054	344*	434*	93.9*
1939	8.459	365	443	94.2	1938	9.279	313*	437	95.1*
1940	10.054	344	434	93.9	1936	9.275	356	445*	90.1*
1941	18.799	355	429	96.1	1942	8.682	364*	454*	95.6*
1942	8.682	364	454	95.6	1937	8.553	353*	448	92.0
1943	6.795	235	349	91.6	1939	8.459	365*	443*	94.2*
1944	10.495	363	406	92.7	1945	8.034	300	403	--
1945	8.034	300	403	--	1943	6.795	235	349	91.6*
Average	9.843	334.5	423.6	93.5	Average	9.843	334.5	423.6	93.5

*These production figures when compared with the total rainfall of each year show that the amount of rainfall is good for estimating yearling steer gain in only 50 percent of the years; for calf weights only 30 percent; and for calving percent only 30 percent, the exception being 1943 with extremely low rainfall.

gains 10 years out of the 10 or 100 percent correct. The best months or series of months for estimating likely yearling steer gains are:

January, February, March, and April	100 percent
January, February, March, April, and May	90 percent
January, February, and March	80 percent
February, March, and April	80 percent
February, March, April, and May	80 percent
August, September, and October	80 percent
February and March	70 percent
March, April, and May	70 percent
August	70 percent
August and September	70 percent
January and February	70 percent.

Rainfall of all other months or combinations of months had 60 percent or lower values for estimating steer gains and were therefore considered unreliable.

Because rainfall limits the growing season to July, August, September, and half of October, a year's feed must be produced at this time. Therefore, we cannot stock to a capacity that would consume all the feed grown in these months. Since more feed is on the ground during the late summer season than can be eaten, our stock are always gaining as much as possible even though variations in amount of rainfall during these months make a difference in the amount of feed. An animal can eat only a given amount of feed regardless of how much is before it, and if it cannot consume all the available feed, its gain will not be changed by variations in amount. For these very evident reasons, we find no large effect on yearling steer gains caused by rainfall in July, August, September, and October. This fact is probably also true on any other moderately stocked range with like seasons.

The low-rainfall months of February, March, April, and May give a different picture with the yearling steer gains affected 90 to 100 percent by variation in rainfall in these months. These are, of course, the months when there is no green grass, not only because of the freezing weather, but because the rainfall would be too low to support grass growth. These late winter and spring months can when there is above-average rainfall produce considerable weeds that are excellent feed in themselves, supplying protein and vitamins and also probably increasing the appetite of the stock so that they consume more old grass. A little extra rainfall producing extra feed in these low-feed months is what makes the 25- to 100-pound annual difference in steer gains for us. The good feed period, which is 4 or 5 months long when the spring is dry, is 7 to 9 months in length if the spring is wet. Possibly if the right quality and amount of supplemental feed were fed during these months, a reasonable profit would be made. Possibly one should start feeding supplements January 1 and continue until weeds or green feed is produced. The only reason for keeping yearling steers is for gain, and if the gaining period can be prolonged for an extra 3 or 4 months by watching the range and rainfall, it should be profitable.

Calf weights: The weight of calves is not materially influenced by extra rainfall or weed crop in the winter or spring months, but some changes resulting from variation in amount of August and September rainfall have been noticed. This is probably due to the fact that milk from the cow supports the calf in April, May, and June, the relatively dry months, and that the grass is usually green and

succulent in July, August, and September, when the calf starts eating increasing amounts. As has been stated before, because of the rate of stocking, there is usually an overabundance of grass during the months the calf is on the range. We would expect, therefore, a rather uniform weight except in years like 1943, 1944, and 1945. Both 1943 and 1945 were low-rainfall years in winter, spring, and late summer. Although 1944 had good summer rains, the age of the calves was short because of late breeding in the drought year of 1943.

Percent of calf crop: When cows are on ranges with plenty of grass and therefore are usually strong physically, the preceeding year's feed conditions are thought to control the present year's calf percent. As before stated, the bulls are with the cows only from June to September on this ranch. The amount of rainfall and therefore quality and quantity of feed in these months should naturally greatly affect the percent of calf crop. This is true since the combined rainfall of July, August, and September; the August rainfall; and the combined rainfall of March, April, May, June, July, August, and September were 90-percent reliable for estimating next year's calving percent. Most combinations of monthly rainfall from which one could predict the calf crop with at least 70 percent accuracy, included the late spring and summer months. Therefore it seems that continued good feed over 3 or 4 months before breeding, or extra good feed at breeding time, determines next year's calf percent.

Possibly feeding supplemental feed in the late winter and spring months of light rainfall years would insure continued strength in the cows until breeding time and therefore increase calving percent. As in supplementing the yearling steers' feeding, possibly a good plan would be to start supplemental feeding on this ranch January 1 and continue until enough rainfall has fallen to start weeds or grass.

Conclusion

1. Late winter and early spring months are the critical months in determining total yearling steer gains on this ranch.

2. Continued rainfall through March to September and heavy rain in July, August, and September result in large calf crops next year under our system of seasonal breeding.

3. Weaning weights of calves are mostly dependent upon amount of rain that falls while they are nursing their mothers, especially rainfall after the calves are 3 to 4 months old when they start eating grass.

4. Total annual rainfall, unless considerably below average, is not necessarily a good index for livestock gains on a moderately stocked range such as the college ranch.

5. On overgrazed or heavily stocked ranges where there is little feed storage, the above conclusions would probably be reversed, since the effect of rainfall on feed supply would be more critical and the stock would react more promptly.

VITAMIN A FACTOR OF RANGE FORAGE

W. E. Watkins

The enclosed plots which can be seen to the west in the distance are used in collecting experimental samples of grass and forage. Mesa dropseed and black grama are the two main grasses, both on these plots and on the surrounding range.

We are able to find out many things nutritionally about cattle by watching what they are eating. As a general rule, they select the more palatable feeds that are available. Hunger and palatability do not depend upon a single factor. It has been found instead that there are at least ten specific hungers, which are for protein, fats, carbohydrates, water, oxygen, salt, calcium, phosphorus, sodium, and certain vitamins. Thus, the more palatable feeds may contain most or all of these factors and the cow eats them because she has a definite hunger and need for them.

One of these hungers and needs is for the vitamin A factor. All green forage is rich in this vitamin. Accordingly, the amount present in various pasture grasses is dependent upon the growing season and the stage of maturity.

What does a lack of this vitamin A factor do to livestock? An acute or severe shortage of vitamin A produces dead, weak, or blind calves. In mature animals there is damage to the mucous membranes of the body, which in turn affects reproduction, general health, and the nervous system. The membranes of the eye are also affected and weakened, which is the cause of some sore eyes.

It has been found by the Texas Experiment Station that it takes from 3 to 6 months to deplete range cattle of their vitamin A. It is clear how depleted the vitamin A might become in cattle during a drought of 6 months or longer.

Both mesa dropseed and black grama grasses contain large quantities of this vitamin A factor during the active growing season. In mesa dropseed grass, the above-ground portion dies at the beginning of freezing weather and soon loses its vitamin A value. The black grama grass, the upright stems of which remain green from 4 to 6 inches above the ground throughout the winter, contains an amount of the vitamin A factor sufficient to satisfy the requirements for maintenance, and in most years a large part of the increased amounts needed for gestation and lactation may be provided. Analyses of black grama grass every 28 days for 7 years show that in all but 1 year the vitamin A factor was adequate for cows nursing calves.

During the late winter and early spring when the vitamin A factor is lowest in the grasses, there is often a growth of weeds and annuals which are very high in this vitamin. In 2 years' results of blood analyses, it has been found that the vitamin A potency of the blood rises surprisingly high because of the early growth of weeds and annuals.

Browse plants such as chamiza, soapweed, and others contain the vitamin A factor. A limited number of chamiza analyses have shown this browse to be as high in the vitamin A factor as good quality alfalfa hay or even higher. It is important to consider the benefits gained by having some of those browse plants

especially in sections of the state where the severe winter causes the grasses to be completely dormant.

On this range in southern New Mexico, with the average amount of rainfall and with the usual pattern of distribution, the cattle seem to have adequate amounts of vitamin A. The mild southwest winters allow much green grass to remain on the range. However, after 3 months or more of drought, this vitamin can very quickly become one of the major shortages.

EFFECT OF RODENTS AND RABBITS ON GOOD AND POOR RANGE

K. A. Valentine

We are making this stop to present the results of a study of the effect of rodents and rabbits on good black grama range and on poor deteriorated range. I am sure you will all agree that the range area immediately surrounding these plots is very poor, with very few desirable forage plants. Yet our rainfall records indicate that the site here receives just about the same amount of rainfall as the ranch in general, and the soil is about the same as that on our better grassland areas. In order to determine what effect rodents and rabbits were having on the area, these plots were established in the fall and winter of 1939-40. Prior to establishment of the plots, cattle had been totally excluded from the area for 4 years. Now 6 years after establishment of the plots, we are able to see quite clearly the reason for the poor condition.

At the outset of this study, the stand of grass on the different plots was about the same. Last fall a survey showed that the stand of grass on the plot closed to rodents and rabbits was more than 5 times as dense as at the beginning of the experiment. The plot closed to rabbits and open to rodents had shown only a 25 percent increase in stand, and the 2 plots open to rodents and rabbits had shown an average decrease of about 75 percent. Yields of grass vegetation as determined this fall are in line with the differences in stand. The rodent exclosure produced at the rate of about 200 pounds of grass vegetation to the acre. The rabbit exclosure produced about 45 pounds to the acre, and the two plots open to rodents and rabbits produced about 2 pounds to the acre. It might well be noted that the plot receiving protection from rodents and rabbits does not yet exhibit as good a stand and yield as our better grassland, but it is to be expected that this plot will show more improvement with continued protection.

It is clear enough that rodents and rabbits have had a great deal to do with the very low state of production on this range; in fact, not only have they prevented an improvement in the cover, but they have actually brought about a deterioration during the period of the study. When we compare the results obtained in the rodent exclusion plot with those of the rabbit exclusion plot, we may reasonably conclude further that the rodents are chiefly responsible for the damage to the grasses. However, we should not be too quick to condemn the rodents as chief offenders. There is slightly more than twice as much mesquite brush in the rabbit exclosure as in the rodent exclosure. You can get an idea of how this has affected the grass in the rabbit exclosure by looking over the northwest corner of the rodent exclosure. Here several large mesquite plants are aggregated, and very little grass is present among them even though rodent protection has been the same over the whole plot. These observations indicate that the rodents are certainly not solely responsible for the difference in grass cover and yield between the rodent and rabbit plots. Our earlier study conducted in the original rodent plot acress the road bears out this conclusion; in fact, the old plot underwent a marked improvement in stand and yield even though a number of rodents were present in it all the while.

These observations indicate that, while rodent and rabbit damage is a material factor in the low production of grass vegetation in such types as this,

the shrubs too exert an adverse effect on the grasses. More will be said later in the day on this important subject. Meanwhile it is well for us to realize that we do not have separate and distinct problems with rodents and rabbits on the one hand and noxious shrubs on the other, but a complicated problem in which rodents, rabbits, and shrubs all appear as factors. The magnitude of the combined effect of these factors is well shown by the results obtained over most of the rodent plot and indicates to us the real improvement in grazing values that awaits the solution of this problem.

Now when we turn our attention to rodent and rabbit effects in well-preserved open black grama grassland such as we will see later in the day, we find that they are almost nil. Plots protected from rodents and rabbits have shown little difference in either stand or yield from plots open to rodents and rabbits. Now this does not mean that there are no rodents or rabbits in this grassland. Dens of kangaroo rats are not uncommon there and were present around the study plots. Both jack rabbits and cottontail rabbits are also present in the vicinity of the study plots, but none of these are numerous enough in comparison with the abundant supply of forage to have a material effect on stand or production of forage.

We conclude from this plot set-up that we need not be concerned with rodent or rabbit control in our well-preserved grassland range, but that we should concentrate our efforts at control where we have seen that control is needed.

PICKING THE BETTER PRODUCING COWS

Marvin Koger

Even after the most rigid selection of breeding animals, there is a great amount of variation in the weight and grade of calves produced by different cows. If this difference in production is consistent, that is, if the cows that produce substandard calves one year tend to do likewise in other years and those that have good calves tend to have better calves in following years, it would afford a means of selecting breeding stock for their production as well as for their individuality. This would help breeders to sort out the better producers, or, probably more important to commercial breeders, enable them to cull the poorer producers from the herd. As efficiency of production becomes more important in order to meet competition, and sometimes low prices, a tool of this kind in selecting breeding animals becomes invaluable.

Beginning in 1935, complete records have been kept on each animal on the ranch. The records accumulated during this time have given us some definite information on the production of cattle and how much one or more calves will tell us about the future production that can be expected from a given cow. We believe that what we have been able to learn from records will be useful to cattlemen in their breeding operations.

Since calves vary in age at weaning, it was necessary to correct weights to a standard age. Also, in evaluating a calf weight, it was necessary to take into account the sex, since our records show that steer calves weigh about 30 pounds more than heifers at weaning time. In other words, a cow producing a steer calf was considered to have the same producing ability as a cow weaning a heifer calf 30 pounds lighter. Weights vary widely from year to year because of feed supply, so it was necessary in using weights from different years to express weight as in relative terms. To do this, a calf weight was expressed in pounds deviation from the average of cows of the same age, or as a percentage of the same average. This made it possible to compare calves produced in different years. This measure is not necessary when only one year's data are being considered. The calves were graded from A plus to C minus and in order to handle the grades mathematically, a value of 130 was given to A plus and each succeeding grade lowered 10 points. This gave a C minus calf a value of 50.

The data summarized in the tables show that weight of calf produced by a 3-year-old cow gives a good indication of what will be the relative weight of calves produced in the future. Of the 3-year-old cows producing calves weighing in the lower 10 percent of the group, only one has in subsequent years produced calves of average weight. The cows that produced the heaviest calves as 3-year-olds subsequently produced calves that were, on the average, 52 pounds heavier than those of cows that produced light calves as 3-year-olds.

Similarly, the grade of the first calf produced was correlated with grade of calves produced in subsequent years. The correlation was not quite as high as that for weight, probably because we do not have a definite measurement as with weight. However, of the cows that as heifers, produced B minus calves, none have subsequently produced calves that have graded as high as the average for the herd.

When both weight and grade were considered and a composite value given the calf, a similar correlation was found. Thus our records show that if a person made a 10 percent cull of the first-calf heifers on the basis of the calf produced, only rarely would a good cow be culled, and most of the poorer producers would be removed. Similarly, if a person selected the first-calf heifers with the best calves, most of the better producers would be included. It should be pointed out that in following a plan of this kind, the calves of heifers should be compared as a group and not mixed with calves from older cows. The calves of 3-year-old cows here on the ranch average about 60 pounds lighter than those of mature cows. Also, there appears to be less top-gradeing calves among the heifers.

It is realized that most ranchers do not have the time nor facilities to keep as elaborate records as we do on the college ranch. It might well be asked if the results reported above can be used on ranches where individual records are not kept and scales are not available. We think they can. Certainly an experienced cow man can spot a calf substandard as regards either weight or type. Such calves could be "mothered up" and the cows removed or marked for shipment. Likewise, the better producers could be spotted by mothering up the outstanding calves. This should require no more handling than is frequently done when branding calves from a herd carrying different brands. It would require, however, that the younger cows be run separately or sorted out for the purpose.

From the standpoint of the producer, it is fortunate that only one calf is necessary to get an idea of the producing ability of a cow. This enables selection to be made early in the life of the cow and requires no great, and sometimes not any, departure from regular management practices. In fact, our records show that almost as much can be told from the cow's first calf as from two or three.

A program of picking breeding females based on proper selection of replacement heifers, supplemented by a weeding out of the poorer producers after their first calf is weaned, cannot help but contribute to a more efficient and economical production of beef.

WEIGHT OF CALF PRODUCED AS A 3-YEAR-OLD COMPARED WITH THE AVERAGE OF THE NEXT 4 CALVES.

Percent of calves in group	Average 3-year-old calf weight	Average of next 4 years' calves
	Pounds	Pounds
8	321	404
22	349	417
37	383	430
23	409	443
10	441	456

GRADE OF CALF PRODUCED AS A 3-YEAR-OLD COMPARED WITH THE AVERAGE OF THE NEXT 4 CALVES.

Percent of calves in group	Grade of calf as a 3-year-old	Average grade of next 4 calves
7	80 (B minus)	92
23	90 (B)	95
38	100 (B plus)	99
24	110 (A minus)	102
8	120 (A)	110

CALF PRODUCTION AS A 3-YEAR-OLD COMPARED WITH THE NEXT 4 YEARS WHEN BOTH GRADE AND WEIGHT WERE CONSIDERED*.

Percent of calves in group	Value of calf (Average of group)	Value of next 4 calves
6	88	95.2
11	93	97.2
30	98	99.2
30	102	100.8
18	108	103.2
5	112	104.8

*The composite value was secured by expressing both grade and weight of calf as a percent of the average for the group and the 2 percentages averaged.

CORRELATION AND REGRESSION COEFFICIENTS FOR FIRST YEAR'S PRODUCTION AND AVERAGE OF SUBSEQUENT 4 YEARS' PRODUCTION.

Factor studied	Correlation coefficient	Regression coefficient
Weight	.62	.44
Grade	.39	.34
Weight and grade combined	.41	.40

SUMMARY OF RESULTS OF RESEEDING TRIALS

K. A. Valentine

Range seeding experiments on the college ranch were started in 1936 and have been continued to date. Well over a hundred different species of plants, mainly grasses but including a few shrubs and weeds, have been used. Needless to say most of these have proved to be unsuited for range reseeding under the conditions represented here. Only a very few, however, have shown promise and still fewer have been really successful; in fact, there are but two grasses, Lehmann lovegrass (Eragrostis lehmanniana) and Boer lovegrass (Eragrostis chloromelas), which we consider successful at this stage of our work. Considering the conditions that prevail here, Lehmann lovegrass has given excellent results. This does not mean that we have not had failures with it in some of our plantings, but a certain proportion of failures are inevitable. We must remember that even the best adapted of our native grasses sometimes fail to reproduce themselves or even to hold their own in unfavorable years. Perhaps the strongest point in favor of Lehmann lovegrass is the relative ease with which we have been able to get stands from seeding. We have not been quite so successful in getting stands of Boer lovegrass, but stability of stand fully compensates for this lack. The great importance of stand stability can hardly be overemphasized.

Another grass, Rothrock grama (Bouteloua rothrockii), a native of southern Arizona and southwestern New Mexico, has not proved to be of high value for reseeding under our conditions. This grass has produced some of the best and fastest-developing stands of any tested here, but almost without exception these have become greatly reduced after a season or two.

Another point that has been brought out by our work here is the importance of making some kind of preparation of the soil before planting. We have had very little success when plantings have been made without soil preparation. Likewise we have found that it is necessary to actually plant the seed and not merely scatter it on the surface of the soil. The seed should be covered by 1/4 to 1 inch of soil. We have obtained best results with Lehmann lovegrass by planting about 1 to 1 1/2 pounds of seed to the acre. With Boer lovegrass we think the rate of seeding should be a little heavier--probably 2 or 2 1/2 pounds to the acre.

Chances of successful seeding under our conditions are not 100 percent, as you might well guess. We have had some total failures. Our records show that we have made successful plantings only in years when rainfall during the summer growing season, that is the months of July, August, and September has been about 5 1/2 inches or more. They show that we have had failures when the growing-season rains totaled less than 4 1/2 inches. They also show two failures with summer seasonal rainfall just a little less than 5 1/2 inches, but one of these we believe due to poor soil conditions at the planting site and the other to the fact that the planting was made late in July, thus missing the benefit of a good heavy shower the early part of the month. Our very excellent results in 1942, when rainfall during July, August, and September was just a little over 5 1/2 inches, lead us to think that we have pretty good chances of success when summer seasonal rainfall is over 4 1/2 inches. Now this does not mean that we cannot have a failure when summer seasonal rainfall is high, nor that we are foredoomed to failure when it is a little

low. Distribution of rainfall has much to do with results. We have noted that it takes a good soaking rain to bring the seedlings up. We might get such a rain in a year when the growing-season rainfall is low and as a result have a successful planting, and we might fail to get such a rain in a year when the seasonal total is good and consequently have poor results or failure. By and large, however, in years of good seasonal rainfall we have had two or more good heavy showers during the growing season; and we have not had such showers in the years of poor seasonal rainfall. We may justifiably conclude that years of higher seasonal rainfall are more favorable for reseeding, not simply because of amount of rainfall, but also because of the occurrence of the more effective heavy rains.

Examination of the 30-year rainfall record from the Jornada Experimental Range headquarters, which may be considered representative of conditions over the whole Jornada plain, shows that 15 of the years had less than 4 1/2 inches of rain during the summer growing season. These we would probably do well to consider unfavorable for successful reseeding. Ten of the 30 years have had more than 5 1/2 inches of seasonal rainfall, and we may rightly consider them as favorable, with good chances of success. Five of the years had between 4 1/2 and 5 1/2 inches of seasonal rainfall; these years we may well put down as uncertain, with about a 50-50 chance of success. From this record we may fairly conclude that 12 or 13 years presented fair to good chances of success and 17 or 18 years presented little or poor chances of success.

Now we would like to present a little information on the costs of our seeding operations. When we have single-disced just ahead of the drill, we have planted an average of 2.77 acres per hour. In this year's planting, which we double-disced, we planted 1.28 acres per hour. Using a rate of $1.50 per hour, we have a figure of $.54 per acre for the single disc planting and $1.17 per acre for the double disc planting. With a seed cost of $.75 per acre for Lehmann lovegrass (1 1/2 poundsat $.50), we have a total of $1.29 per acre for the single disc planting and $1.92 per acre for the double disc planting. Unfortunately we do not have any reliable estimate of the cost of Boer lovegrass seed. Present information indicates that it will be higher, and since the seeding rate should be greater, the seed cost per acre will be more than for Lehmann lovegrass. Considering the greater stand stability and higher palatability of this species, however, we feel that some higher cost is warranted.

Now let us consider the production and grazing value of these two lovegrasses. Clipped plots have shown yields of Lehmann lovegrass to be about 425 pounds to the acre and of Boer lovegrass about 330 pounds to the acre. These yields were from stands in their second year of growth and are very probably not so great as would be obtained from older and better established stands. By comparison, the yield of an average stand of black grama grass in the same season was about 350 pounds per acre. We have conducted two grazing tests on these lovegrasses in December, when the greater part of the plants had been killed by cold weather and only a little green material remained at the base of the plants. In both years, Boer lovegrass was used to a much greater extent than Lehmann lovegrass. Boer lovegrass was used down to about a 2-inch stubble the first year and about a 3- to 3 1/2-inch stubble the second year. A stubble height of Lehmann lovegrass varied from 4 to 10 inches the first year and from 4 1/2 to 24 inches the second year. The high stubble heights represent very light utilization, the animals having eaten little

more than the seed heads. Our work has not yet indicated just how much we should graze these grasses, but it has shown that both yield a generous amount of palatable forage.

We have observed that both these lovegrasses grow earlier in the spring and later in the fall than black grama grass. It is at these times of the year and particularly in the spring, when our southwestern semidesert ranges are lacking in green feed, that these lovegrasses will probably be most valuable to us.

RANGE RESEEDING RESEARCH IN NEW MEXICO

By J. O. Bridges, Forest Ecologist
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By an Act of Congress a range reseeding research fund was set up last July 1 for use in the western United States. The development of the research program under this Act has been delegated to the Forest Service experiment stations. At present this fund is not large and it fully warrants enlarging commensurate with the problems at hand. In order to stretch the present fund as far as possible and to guard against any duplication of effort, the Southwestern Forest and Range Experiment Station has set up its program in cooperation with the New Mexico College of Agriculture and the University of Arizona.

The work as now planned is to cover two phases: (1) technical and practical research on species, proper time of year to plant, cultural methods necessary for seed bed preparation and covering seed, necessity for eliminating competition of low-value plants such as snakeweed and mesquite, when and how to graze newly seeded areas; and (2) furnishing advice and guidance to interested stockmen and such public agencies as the Division of Grazing, Soil Conservation Service, and the Administrative branch of the Forest Service, who may wish to undertake reseeding programs of their own.

I have been put in charge of the program in New Mexico and will endeavor to give you an insight into how the program is being set up, what we have done, and what we expect to do.

Range reseeding research is still largely on a trial and error basis. This means we must make a large number of trials with the expectation that many will be failures but with the hope that some will be successful. For each of these trials a particular site must be selected. Just where to locate these sites was our first problem. Thought on this problem led to several considerations. First of these is the varied climatic conditions found in New Mexico. On the basis of elevation and rainfall, the state can be divided into five or six general climatic areas, such as the high mountains, west central plateau, southwestern semidesert, eastern plains, and northwestern semidesert. Each of these can be further subdivided into from two to six subareas on the basis of native vegetation and local climatic variations, making eighteen to twenty distinctive climatic areas. In each area different species of plants are likely to be best adapted.

With our limited funds it was obviously impossible to set up experimental plots in all these areas. In selecting the ones in which we would work first, pending the availability of additional funds, we were guided by the following considerations:

1. Amount of research work already done
2. Number of dependent people concerned
3. Immediate need of these people for relief from present conditions
4. Possibility of range forage improvement
5. Water-yielding value of the area
6. Silt-yielding capacity.

The largest amount of organized research which has already been done in New Mexico is right here on the college ranch and Jornada Experimental Range, the results of which are applicable to roughly 15 to 20 percent of the state. Another 30 to 35 percent of the state--the eastern plains portion--has had the benefit of the field trials of the Soil Conservation Service and the more detailed studies of the Bureau of Plant Industry at their Tucumcari Station. However, in both of these areas much remains to be learned. In the rest of the state there has been very little research on range reseeding. We still need to know what species to seed, how to plant them, and how best to manage them after they are established.

A large portion of the state's population resides along the Rio Grande and the Pecos River and their tributaries. These people are more or less directly dependent upon the natural resources of these river basins for their livelihood, either in the form of forage for their grazing animals on the hills and mesas or in the form of irrigation water for their crops in the valleys. In the upper portion of these watersheds there are many small but densely populated communities which are directly dependent on the surrounding native forage resource. This resource has been much depleted from its original condition and these communities are in immediate need of relief.

Much of what was once high-producing bunchgrass range at the higher elevations has been replaced by such low-producing grasses as blue grama and Kentucky bluegrass. These in turn in many places have been replaced by non-forage-producing plants such as snakeweed and pingue. Blue grama and Kentucky bluegrass, under proper climatic conditions, are two of our very best grasses, but at elevations above 6,500 feet blue grama, in ordinary years, makes very little usable forage. Likewise, Kentucky bluegrass produces only a small volume of forage in most New Mexico mountains because of the limited rainfall. Experience seems to indicate that, after adjusting grazing use, the quickest and most economical method of bringing these low- or non-producing ranges back to high production is reseeding to adapted species.

The upper portion of the Rio Grande and Pecos River watersheds consists largely of high mountains and is the portion of the state that receives the greatest rainfall and thus is the portion that yields the most water for the irrigation systems of the state. These are largely seasonal ranges important for both cattle and sheep. On both winter and summer ranges there is great need for increased forage.

Just below the high mountains but still in the upper portion of these watersheds is an area intermediate in elevation but with low rainfall; it is well typified by the Rio Puerco drainage, a tributary of the Rio Grande. Here the vegetation was never very dense and has been much depleted by too heavy use combined with recurrent droughts. Ordinarily the water-yielding value is low but the silt-yielding capacity is high due to the sparse nature of the vegetation and the high intensity of the summer showers. Thus from this part of the state our irrigation reservoirs receive 15 to 20 percent of their water and from 80 to 90 percent of their silt deposits. These ranges are used on a yearlong basis by both cattle and sheep. Here again there is need for increasing the forage supply to maintain present numbers of livestock satisfactorily.

For these reasons it has been decided that the upper portion of the watersheds of the Rio Grande and Pecos River should be the first to receive attention in the new range reseeding research program.

To date three sites have been selected, fenced, and seeded. One of these is on Jarita Mesa in the ponderosa pine type, about 50 miles north of Espanola. Another is at Taos Junction in the sagebrush type, about 20 miles west of Taos. And the third is in the pinon-juniper type on Glorieta Mesa, about halfway between Santa Fe and Las Vegas. Next year we expect to be able to establish three or four additional experimental areas. For example, we have in mind an area near Corona where findings should be applicable to a wide scope of country.

In setting up our program several objectives appeared to be desirable. One of the primary objects is to determine for each climatic area of the state the best adapted species, native or introduced, for reseeding. In determining these species the following factors will be considered: ability to become established, ability to reseed naturally after becoming established, volume production, erosion-control value, palatability to livestock, resistance to grazing, and ability to survive in mixtures. Another primary objective is to develop ways and means of establishing these species economically on large areas of range land. This may involve the development of special machinery, cultural methods, studies on depth of planting, rate of seeding, and time of year best suited to seedling establishment. A third major objective is to develop a system of grazing management whereby we will be able to hold the gain made by reseeding.

Some secondary objectives are: (1) The development of mixtures that will provide season-long grazing use; also, if possible, to discover a legume that will fit into these mixtures. (2) To determine the effect of source of seed on the volume of forage porduced. (3) To test the value of commercial fertilizers as an aid to the establishment of, and subsequent effect on, volume of forage produced by the more important reseeding species. (4) To integrate the reseeding program with other programs currently under way, such as watershed management and control of poisonous or noxious weeds.

To attain these objectives, plots of various kinds and sizes will be established. In the adaptation trials the plots will consist of three 12-foot rows spaced 1 foot apart surrounded on all sides with a buffer strip 3 feet wide. From 100 to 200 of these will be established at each experimental site. Four hundred fifty of these have already been planted. Incidentally, I would here like to give credit to the nursery divisions of the Soil Conservation Service and the Bureau of Plant Industry for furnishing many of the seeds used in these tests.

Species that show themselves adaptable in these tests will be planted in larger 1/4-acre plots where their ability to survive and reseed naturally can be observed and where their volume of production can be measured. We have about 75 plots of this size planted at present. These 1/4-acre plots can also be used to develop the best cultural methods, test various rates of seeding, and also to test the value of fertilizers.

Species that survive these tests will be planted in blocks of 10 or 20 acres or even larger to test palatability to livestock, resistance to grazing, ecohomy of establishment, etc. In cooperation with the Administrative branch of the Forest Service, we will have by next July 1 about 30 of these larger scale plantings. Thus by telescoping the normal procedure of our plan, we hope to have some usable results within 2 to 3 years' time.

Earlier I mentioned that part of our program was to furnish advice to interested parties on reseeding. Later I indicated that we did not know much about reseeding and were setting up our research program to remedy this. Actually we do

know a little about reseeding already. We have the results of the work here on the college ranch and the Jornada Experimental Range which apply to this part of the state. We have the results of several years of investigation in Utah and Nevada by the Intermountain Forest and Range Experiment Station, which apply more or less to the higher elevations of the state. And we have the results of the Soil Conservation Service field trials and the Bureau of Plant Industry experimental stations at Tucumcari, New Mexico, and Woodward, Oklahoma, which apply to the eastern plains portion of the state.

As a result of the investigations by these agencies and others, certain fundamental principles have been established:

1. Species limitations; a species that does well in one locality may be entirely unsuited to another--thus crested wheatgrass is not well suited to this part of the state even under irrigation, while in the northern part of the state it is an excellent grass. Likewise, Lehmann's lovegrass, which as you see does well in this part of the state, is entirely unsuited at Portales and northward.

2. Seed bed preparation; some sort of preparation has been found to be necessary in nearly all situations and especially where the ground is already occupied by native vegetation, such as weeds or brush.

3. Method and rate of seeding; seed must be covered to the proper depth for its size and must not be too thick for the available moisture.

4. Season of planting; every locality has its best season for planting--in some places this is late fall, in others early spring, and in still others, midsummer.

5. Care after seeding; even under ideal conditions, young, tender seedlings need some protection from grazing until they get their roots firmly established. Under adverse conditions found on some deteriorated range land they may need protection for 2 or 3 years.

We realize that range reseeding is not the answer to all our forage problems. It is obviously impossible to reseed steep, rocky, mountain sides, dense brush areas, and many others, but we are confident that on favorable sites much can be done to increase our range forage supply. However, much time and effort will have to be devoted to the problem before we can prescribe the proper species to plant and methods to use for their establishment in each of the climatic areas of New Mexico.

SEASONAL USE OF MINERAL SUPPLEMENTS

J. H. Knox

Experiments on the use of mineral supplements at this station have covered a period of 15 years. Although the deficiencies of phosphorus and calcium are not so great on this range as in some parts of the state, an average increase of about 50 pounds in the production of each cow was obtained. This increase was partly due to more calves weaned and partly to greater weight of calves at weaning time. In more recent years, work on the composition of range forage has shown great seasonal variation in the calcium and phosphorus content. The amount of these elements in the green growing grass of summer may be more than double that in the dry grass of late winter and spring.

An experiment was started April 1, 1941, and concluded July 17, 1945, to compare the feeding of a mineral supplement during winter and spring with yearlong feeding. Bone meal was the supplement used until the spring of 1944, when bone black was substituted because of the scarcity of bone meal. The calcium and phosphorus content of these substances is very similar.

AVERAGE SALT AND MINERAL CONSUMPTION

Plan of mineral feeding	Continuous	Seasonal
Days on experiment	1568	1568
Number of cows	16	16
Salt per cow daily, ounces	.87	1.37
Bone meal per cow daily, ounces*	.87	.37
Salt per cow yearly, pounds	19.8	31.3
Bone meal per cow yearly, pounds*	19.8	8.4
Yearly cost per cow, dollars**	.79	.57
Saving per cow from seasonal feeding, dollars	--	.22
Increased return per cow from yearlong feeding with calf at 10 cents a pound, dollars	4.10	--

*Bone black was used after March 28, 1944.
**When special steamed bone meal costs $60 and salt $20 a ton.

Thirty-two grade Hereford cows varying from 4 to 6 years of age, which had been raised on the experimental range, were divided into two uniform groups based on age, weight, and previous production. The groups were run in adjacent pastures. They were weighed at 28-day intervals and changed from one pasture to the other at that time. This was done to make the grazing conditions of the two lots as uniform as possible. A mixture of equal parts of bone meal and salt was fed to one lot from soon after the first killing frost until there was a substantial amount of green feed in the spring. Length of feeding period varied from 112 days in 1944-45 to 196 days in 1942-43, with an average of 147 days for the 4-year duration of the experiment. Salt alone was fed this group for the remainder of the year. The other group received the bone meal-salt mixture continuously.

The results are shown in the accompanying tables. The cows in the seasonal-fed lot ate about 11 pounds less mineral supplement each year but their annual salt consumption was increased by a like amount. The saving from seasonal mineral feeding when the mineral supplement was valued at $60 and salt at $20 a ton was less

than 25 cents yearly for each cow. The average weight of calves at weaning time was the same in each lot but there were more calves born in the lot which received mineral supplement the year around and fewer died. As a result, 60 calves were weaned from 64 cows bred in this lot as compared to 54 in the seasonal-fed lot. The cows in the continuously-fed lot produced an average of 41 pounds more each year because of the larger number of calves weaned. A further fact of interest is that 12 of the 14 original cows remaining in the continuously fed lot at the end of the experiment weaned a calf each year. Of the 10 original cows remaining in the seasonal fed lot, only 5 raised a calf to weaning age each year.

SUMMARY OF PRODUCTION FOR 4 YEARS

Plan of mineral feeding	Continuous	Seasonal
Number of cows	16	16
Total number of cows bred	64	64
Number of calves born	63*	61
Number of calves died	2	7
Deaths unrelated to nutrition	1	1
Deaths probably unrelated to nutrition	0	1
Deaths which may have been caused by faulty nutrition	1	5
Number of calves weaned	60	54
Percent calf crop	93.8	84.4
Weaning weight of calves, pounds	431	430
Production per cow, pounds	404	363
Number of original cows remaining in 1945	14	10
Number of cows which weaned a calf each year	12	5

*One twin calf in 1945 was removed at 1 week of age.

Summary

We shall continue to recommend continuous feeding of mineral supplements to range livestock in New Mexico for the following reasons:

1. The saving from seasonal feeding is very small.

2. This experiment indicates that the increased production obtained by continuous mineral feeding more than pays for the increased cost.

3. None of the experimental cows were less than 4 years old. The advantage of yearlong mineral feeding may be greater with younger cows.

4. The pastures used in this experiment were rather lightly stocked. Such stocking allows more chance for selection of the more palatable and nutrition feed than on a heavily stocked pasture, thereby making the need for supplements less pressing. This may be particularly true when new growth is just starting in the spring.

Seasonal feeding may be a logical plan when cheap mineral supplements are hard to obtain as they were during the war.

SHRUB CONTROL AS A RANGE IMPROVEMENT PRACTICE

By Kenneth W. Parker, In Charge of Range Research
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One of the best and most effective means of bringing about range improvement is often overlooked. This is the proper adjustment of livestock numbers to the forage supply. It is important to the rancher that he practice sound management and graze his range moderately because of its effect on his pocketbook, and the ultimate permanence of his business. Although adjustment in range use is a difficult problem to solve, it can often be helped by the adoption of certain other range improvement practices. One of these is control and elimination of low-value shrubs and trees. In the area where we are now standing, tarbush (or black brush) which is largely worthless as feed has been eliminated to determine the effect on grass production. This area was cleared in 1936 and the work was done at the request of one of our local ranchers. The tarbush was eliminated by hand grubbing, by CCC labor. Most of the grass that you see here is burrograss. This grass is not highly relished by cattle, but it is a lot better than nothing and certainly a step forward in improving conditions so that more desirable grasses such as black grama may increase.

Elimination of the tarbush has increased the available moisture so that the grasses have responded to the extent that they are visibly more vigorous, produce more forage and render better protection to the soil surface. Measurements taken this fall show that the area cleared of tarbush produces about 3 times the weight in grass (1080 pounds per acre as compared to 327 pounds per acre) as the uncleared area. There is also about 3 times the grass cover. I do not mean to imply that we can recommend wide scale elimination of tarbush by hand grubbing as was done here because it costs too much. However we can readily appreciate the effect of eliminating tarbush competition and it is possible that power machinery can be devised to remove the brush more effectively and economically. Such methods yet remain to be studied.

In 1937 we received funds to undertake the study of the noxious plant problem. Since that time our work on this study has been directed chiefly toward finding out the best methods of controlling such low value plants as snakeweed, burroweed, cholla cacti, mesquite, and juniper. Information is now available on how these undesirable plants may be controlled and has been presented to you in the form of numerous articles, leaflets and previous Ranch Day discussions. This material is readily available by writing the Director, Southwestern Forest and Range Experiment Station, P. O. Box 951, Tucson, Arizona.

The job of finding practical, inexpensive methods of control is by no means complete. In fact we feel that we have just made a beginning in this direction and we have yet a long way to go. Further research no doubt will reveal more effective methods and less hazardous chemicals of which I will speak in a minute or two.

Needless to say, this work was greatly slowed down during the war by lack of funds and reduced personnel. An important phase of the noxious plant problem that

we have given some study is: What is the effect of eliminating these low value plants from range land on grass production and surface erosion? In other words, will it pay to remove low value and otherwise noxious plants from the standpoint of increased forage production--and in the end more beef at lower costs.

We know now that in many instances stockmen can either increase or insure the amount of forage available for their herds through a systematic and continuous effort toward control of noxious plants. In speaking of noxious plants I include not only those whose increase means a reduction in grazing capacity or greater difficulty in handling livestock, but also plants actually poisonous to livestock. Many of these noxious plant problems can be met by proper management and moderate grazing practices. Snakeweed and bitterweed are examples where moderate grazing use will prevent these plants from becoming troublesome. Moderate stocking will also prevent or retard the encroachment of undesirable trees and shrubs. On the other hand, where such plants as juniper and mesquite have become firmly established, no degree of moderation will drive them out. There is no easy way to eradicate or kill our undesirable vegetation. It all costs money. And the most practical means of meeting the problem is to control these plants at the time they start coming in, since it may be done most easily and economically at that time.

However, this doesn't help the fellow very much who has extensive stands of noxious plants. Research no doubt will in time uncover inexpensive chemicals which will kill the undesirable plants and yet will not poison livestock. Within the last few years several organic chemicals or plant hormones have been discovered which have great promise. They have several advantages: They are non-poisonous to either livestock or the person handling them, will kill many kinds of plants, especially the broad leaved ones, but do not injure the grass and only a very small amount highly diluted with water is required. Preliminary tests in Arizona carried on cooperatively with the Arizona Agricultural Experiment Station show that this chemical which for want of a simpler name is called "2-4-D" is effective in killing burroweed. If subsequent study shows that it will do the job, it is our idea that 2-4-D could be applied with a fog machine such as that developed by the Army. Although still a military secret, it has been successfully used under the Army's supervision for spraying certain crops in the Salt River Valley. If it is possible to do so we also plan on trying out a flame thrower on such plants as burroweed and juniper.

In the future we will no doubt see power machinery used extensively for eliminating low value trees and shrubs. With mesquite and juniper for example, we have within recent years seen the development of specialized circular saws and mechanical power-driven grubbing machines. These appear to be meeting wide favor in Texas. Out in western Oklahoma, Dave Savage of the Southern Great Plains Field Station, has successfully adopted the ordinary mowing bar to cut sand sagebrush and shinnery oak.

Now to answer the 64 dollar question. How much good will it do me to get rid of some of this undesirable vegetation? In the case of sand sagebrush, Savage has found that mowing in June for two years in succession at a total cost of $1.50 per acre reduced the sagebrush 97 percent, doubled the grass, increased beef production 57 pounds per acre and boosted seasonal income during one season $6.55 per acre. In Utah and Idaho, another Department of Agriculture study with big sagebrush carried on by the Intermountain Forest and Range Experiment Station,

shows that eliminating the sagebrush competition by burning or plowing followed by reseeding increases the production of forage 5 to 15 times.

In the case of some of our undesirable low value plants such as tarbush in the Southwest we do not know the final answer. We do know that in many instances these undesirable plants will have to be removed before we can successfully reseed. We know that in the case of mesquite, control can be done economically and will result in both increased forage yield, reduced surface erosion, and greater ease in handling cattle. The mesquite that I speak of is the tree form found in southeastern Arizona and Texas. The shrubby, many stemmed mesquite which is so common in the sand dunes here on the Jornada is quite another problem on which we have but little information. In eastern New Mexico and north Texas the shrub-by form of mesquite is rapidly becoming recognized as a pest of major proportions.

In a study carried on since 1940 at our Santa Rita Experimental Range in southern Arizona, control of a moderate stand (80 trees per acre) of mesquite cost $1.89 per acre. This was on land that 40 years ago was open grassland. These costs are based on 1940 prices, requiring about 6 man hours labor and less than a gallon of sodium arsenite to do the job. Although labor costs are higher now, much of this work can be done during slack periods and in many instances the value of the wood for fuel and posts will offset the cost of clearing. As the result of this mesquite control, forage production was more than doubled and annual net income per acre was increased from 13 to 32 cents.(based on 8 cents a pound for beef). This means that the initial costs could be paid off in less than 10 years. Overshadowing these increased returns is the greatly reduced surface erosion resulting from bringing these lands back to grass cover.

We have found that elimination of mesquite from areas originally open grassland is necessary for range improvement. This is especially true wherever the rainfall is less than 15 inches per year. Once low value plants such as mesquite, juniper, snakeweed, and burroweed have invaded and become established in grassland their demands for moisture steadily increase. For example, mesquite will send out shallow roots 50 to 75 feet in every direction, which are very efficient in sucking up the moisture. They have to be efficient because, to produce one pound of mesquite growth requires about 1700 pounds of water, enough to produce three pounds of grass. It is not difficult to understand why the invasion and increase in abundance of such plants results in reduced grass growth.

In concluding, I want to emphasize again that the future productivity of the livestock industry will depend on how well we manage our basic resource, the range. We hear a lot about postwar plans and reconversion of industry. On many of our range lands we are going to have a major job of reconversion if we are to realize the utmost from them in the future. This may be balancing numbers of livestock with forage, fencing, herd improvement, stock water development, water spreading, reseeding, or noxious plant control.

It is at such occasions as this Ranch Day that we can get together and reach a common understanding as to how to proceed.